Reading Comprehension of Monolingual and Bilingual Children in Primary School: The Role of Linguistic Abilities and Phonological Processing Skills

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Abstract

Reading comprehension in bilingual children depends on the extent to which each language is used in daily life. To date, most bilingual studies have focused on children who learn the majority language as their second language (L2 bilingual children). In contrast, bilingual children learning the majority language as their first language (L1 bilingual children) have rarely been addressed. To bridge this gap, this study explored a) mean differences in reading comprehension and its preschool predictors as well as b) differential associations between these variables for children from different language groups. The study included 1,842 monolingual, 269 L1 bilingual, and 237 L2 bilingual children from the German National Educational Panel Study who were assessed on their reading comprehension in grade 4 of elementary school. Preschool predictors of reading included linguistic abilities and phonological processing skills that were obtained in kindergarten. The results indicate that after accounting for the children's socioeconomic background, L2 bilingual children exhibited lower reading comprehension and linguistic skills than L1 bilingual children, who in turn were outperformed by monolingual children. In contrast, phonological processing skills were comparable across groups. Furthermore, the three language groups presented similar relationships between reading comprehension and its preschool predictors.

Keywords: bilingual, reading, linguistic abilities, phonological processing skills.

Reading Comprehension of Monolingual and Bilingual Children in Primary School: The Role of Linguistic Abilities and Phonological Processing Skills

In the global world, with an increasing number of international migrations, bilingualism is an unavoidable challenge for many children. In Germany, 35% of under 5-year-olds either have parents with a migration history or have migrated to Germany themselves (Federal Statistical Office, 2010). Thus, learning the lingua franca of a society seems to be an important task for a sizeable proportion of individuals. The consequences of migration also become relevant in the educational context, where children have to deal intensely with print language. The results of PISA 2018 showed that children with migration backgrounds lagged behind their native counterparts in reading performance with a score gap of 63 points (OECD, 2019). This gap remained large (17 points) even after accounting for socioeconomic status. Similarly, children with migration backgrounds had lower general school achievement (Schnepf, 2007) and were overrepresented in the lowest academic track of secondary school (Schnepf, 2007).

From the bilingualism perspective, the educational disadvantages of children with migration backgrounds are rooted long before school entry, namely, with the beginning of first language acquisition (see Doyle, McEntee, & McNamara, 2012; Hesse, Göbel, & Hartig, 2008). Accordingly, and given the importance of proper reading comprehension for children's educational trajectories, this study explored whether preschool differences in linguistic abilities (i.e., vocabulary, grammar) and phonological processing (i.e., working memory, memory span, phonological awareness) between children with different language backgrounds can explain differences in reading comprehension at the end of primary school. Furthermore, due to the scarcity of investigations about children who learn the majority language as their first and another language as their second language, this study aims to describe the competence profile of these children in comparison with monolingual and bilingual children who learn the majority language as their second language.

Reading Comprehension in Bilingual Children

The poor reading comprehension of bilingual children has been repeatedly documented in different countries and languages (e.g., Germany: Limbird & Stanat, 2006; Norway: Lervåg & Aukrust, 2010; The Netherland: Droop & Verhoeven, 2003; USA: Dalton, Proctor, Uccelli, Mo, & Snow, 2011; Proctor, Silverman, Harring, & Montecillo, 2012). So far, a widely neglected aspect in bilingualism reading research is a potential difference between children who learn the majority language as a first language (and a second language; L1 bilingual) and children who learn the majority language as a second language (L2 bilingual). This differentiation is important to determine the core of bilingual disadvantages (i.e., learning different languages per se or the sequence of language acquisition that may reflect to what extent the language is used), which is in turn crucial for designing intervention programs for specific bilingual groups. The few studies focusing on reading comprehension in various language subgroups we are aware of revealed inconsistent results. For instance, Segerer et al., (2013) reported that L1 bilingual and L2 bilingual children had lower reading comprehension in secondary schools than monolingual children. No significant differences were found between the two bilingual groups which led the authors to conclude that the sequence of language acquisition is relatively unimportant for the reading difficulties of multilingual students. In contrast, in a study by Hesse et al., (2008), bilingual L1 children had significantly higher reading comprehension scores than bilingual L2 children. Therefore, this limited research suggests that a more differentiated categorization of individuals on the basis of their language biography should be made and that it is appropriate to differentiate a group of children who have acquired a language other than German as their second language.

Given the scarcity of studies including L1 bilingual children, the present study focuses on reading comprehension in monolingual, L1 bilingual, and L2 bilingual children to investigate possible differences between language groups at the end of primary school. Furthermore, we

investigated whether possible differences can be traced back to cognitive variables assessed at kindergarten age.

Predictors for Reading Comprehension in Bilingual Children

Linguistic Abilities

Linguistic abilities refer to the ability to derive meaning from spoken words when they are part of sentences or other discourses and, thus, contain lexical as well as morphosyntactic knowledge. In addition to decoding, they are considered to be one of the two essential components for skilled reading comprehension (Hoover & Gough, 1990). When children grow older, the impact of linguistic abilities seems to increase (Catts, Hogan, & Adlof, 2005; Tilstra, McMaster, van den Broek, Kendeou, & Rapp, 2009). That is, children first have to master basic decoding processes before they can read for meaning. Accordingly, studies have shown that decoding abilities are a stronger predictor for reading comprehension at the beginning of primary school, while in later grades, linguistic comprehension seems to be relatively more important for the prediction of reading comprehension (see also Ebert & Weinert, 2013; Gathercole & Baddeley, 1989).

Concerning different language backgrounds, numerous studies have shown bilingual children's inferiority in vocabulary and grammar compared to their monolingual peers (Babayiğit, 2014; Bialystok, Luk, Peets, & Yang, 2010; Droop & Verhoeven, 2003; Dubowy et al., 2011; Lervåg & Aukrust, 2010; Limbird & Stanat, 2006; Verhoeven, 2000). Specifically, Dubowy et al. (2011) showed that L1 bilingual children had lower linguistic abilities in German than their monolingual peers but higher linguistic abilities than L2 bilingual children. It is assumed that the difference in vocabulary between bilingual and monolingual children refers not only to the numbers of words known (vocabulary breadth) but also to the quality of their representation (vocabulary depth) (for the latter see Proctor, Uccelli, Dalton, & Snow, 2009). Bilingual children have less tight semantic networks in their

second language (Droop & Verhoeven, 2003) and therefore have both less extensive vocabularies and fewer associative links between words than monolingual children have. However, even though bilingual children's linguistic abilities in each of their languages are lower than the abilities of their monolingual peers, the conceptual knowledge that underlies their vocabulary in both languages appears to be comparable (Pearson, Fernandez, Lewedeg, & Oller, 1997).

Regarding the prediction of reading comprehension, previous studies have documented a significant effect of linguistic abilities (i.e., syntactic knowledge, morphological skills, vocabulary knowledge) on reading comprehension in both monolingual and bilingual children (Abu-Rabia & Siegel, 2002; Babayiğit, 2014; Bialystok et al., 2010; da Fontoura & Siegel, 1995; Lervåg & Aukrust, 2010; Marx et al., 2015). However, the question arises whether the role of linguistic abilities in the prediction of reading comprehension is comparable among children with various language backgrounds. Some empirical indications suggest that the vocabulary and grammar of the target language may be more important for reading comprehension in the later stage of elementary school in bilingual than in monolingual children (Droop & Verhoeven, 2003; Limbird & Stanat, 2006; Verhoeven, 2000). As argued by Verhoeven (1994), an explanation for this finding could be that the shift from bottom-up decoding into the top-down use of linguistic abilities and prior knowledge seems to be earlier in bilingual than in monolingual children.

Since previous research rarely focused on L1 bilingual children, only a few studies examined the development of reading comprehension and linguistic abilities of this specific group. L1 bilingual individuals may share similar linguistic abilities with monolingual individuals as a consequence of the similar dominant language. However, unlike monolinguals, L1 bilingual children are confronted with two languages simultaneously, which may enhance their similarities with L2 bilingual children (i.e., level and variability of individual differences in linguistic abilities, top-down strategy implementation).

Phonological Information Processing

In addition to linguistic abilities, phonological information processing skills play an important role in children's reading development (Bellocchi, Tobia, & Bonifacci, 2017; Dufva, Niemi, & Voeten, 2001). To acquire basic reading skills, children have to analyze and synthesize units of oral language (i.e., phonological awareness), they have to maintain the phonological information in working memory, and they have to compare the decoded phonemes with information stored in long-term memory. Many studies have shown that phonological information processing skills, including indicators of phonological awareness as well as different aspects of working memory, are important predictors for reading comprehension, particularly in the early stages of reading development (Bryant, MacLean, Bradley, & Crossland, 1990; Jong & van der Leij, 1999; Lonigan et al., 2009; Muter, Hulme, Snowling, & Stevenson, 2004; Wagner et al., 1997).

It has been argued that bilingual children may benefit from the metalinguistic aspect of phonological awareness because they have more access to phonological information than monolingual children. However, the empirical evidence regarding the superiority of bilingual children in phonological awareness compared with monolingual children is mixed (Eviatar & Ibrahim, 2000; Rubin & Turner, 1989; Yelland, Pollard, & Mercuri, 1993). This inconsistency is most likely attributed to the different measures of this construct. While the effect was not found in measures of rhyme production (Muter & Diethelm, 2001), the advantage of bilingualism has been shown in metalinguistic properties, such as a phoneme-onset task (Bialystock, 2013; Eviatar & Ibrahim, 2000; Rubin & Turner, 1989; Yelland et al., 1993). This inconsistency may therefore also be because measures on phonological awareness may be confounded with vocabulary demands if real words of the second language are used as stimuli (e.g., Chiappe, Siegel, & Wade-Woolley, 2002).

The relationship between phonological awareness and reading comprehension seems to be more complex in the bilingual setting. Limbird and Stanat (2006) found a relatively

more stable and stronger effect of phonological awareness on reading comprehension in the monolingual German group than in the bilingual Turkish-German group and argued that this is a result of higher phonological awareness but lower reading comprehension in bilingual than in monolingual children. Although this argument may be debatable, Verhoeven (2000) found similar results in Dutch children. Furthermore, Duzy, Gold, Schneider, and Souvignier (2013) reported an analogous outcome with basic reading skill as a dependent variable, supporting the empirical evidence of relatively higher predictive relevance of phonological awareness on reading tasks in monolingual than in bilingual children.

Working memory, another important component of phonological information processing skills, refers to a system that is needed to maintain information in an accessible state in the face of concurrent processing, distraction, and/or attention shifts (Baddeley & Hitch, 1974; Conway, Cowan, Bunting, Therriault, & Minkoff, 2002; Engle, Tuholski, Laughlin, & Conway, 1999). While bilingual children have been shown to outperform their monolingual peers on a variety of executive control tasks (for review see Bialystock, 2001), only a few studies have investigated whether such an advantage can also be found concerning memory span and complex working memory measures. An underlying assumption could be that bilingual experience might affect working memory performance through its impact on cognitive control, which is necessary to inhibit task-irrelevant language (e.g., Engel de Abreu, Gathercole, & Martin, 2011). However, the empirical evidence is mixed. While some studies show an advantage in the working memory abilities of bilingual children (Blom, Küntay, Messer, Verhagen, & Leseman, 2014; Morales, Calvo, & Bialystok, 2013), others do not provide support for this assumption (Bajo, Padilla, & Padilla, 2000; Bialystock, Craik, & Luk, 2008; Namazi & Thordardottir, 2010).

Concerning the prediction of reading abilities, working memory is important not only for decoding and basic reading skills but also for reading comprehension because it plays an essential role both in coordinating the flow of information —and therefore in generating

contextual understanding of a text— (Baddeley, 2000; Baddeley & Hitch, 1974) and in connecting to the long-term memory (Baddeley, 2003). More specifically, working memory allows for word-to-text integration, that is, single elements or words have to be maintained in working memory until integration has taken place to enable text comprehension. So far, there are no indications why the importance of working memory could be different for bilingual children as opposed to monolingual children. Accordingly, Raudszus, Segers, and Verhoeven (2018) found a similar effect of working memory on reading comprehension in monolingual and bilingual children, which was mediated by syntactic integration in both groups.

Taken together, only a few studies have investigated indicators of phonological information processing as predictors of reading comprehension in different language groups, and the results are rather mixed. Moreover, to the best of our knowledge, no studies differentiated between L1 bilingual and L2 bilingual children in this respect.

Socioeconomic Background

According to the Componential Model of Reading (Aaron, Joshi, Gooden, & Bentum, 2008), reading performance is influenced not only by cognitive and physiological factors but also by ecological domains, such as the home environment and culture. In turn, these are closely associated with, for example, the number of books at home and socioeconomic status, which provide access to different resources that support literacy development.

The results of the PISA assessment in 2018 (OECD, 2019) showed that the reading performance gap between children in the highest and in the lowest percentile of socioeconomic status in Germany reached 113 points, which is 24 points larger than OECD in average. Earlier PISA results (OECD, 2011) reported that socioeconomic status explains approximately 11% of the total variation in student reading performance. Children whose parents have higher-status jobs, on average, demonstrated higher literacy performance than those whose parents have lower occupational status. Students' socioeconomic background has also been shown to be associated with earlier-emerging differences in language abilities and

cognitive competencies that are known to be predictive for differences in reading comprehension (Dubowy, Ebert, Maurice, & Weinert, 2008; Hart & Risley, 1995). At least in Germany, socioeconomic status seems to be confounded by children's migration or language background (Dubowy et al., 2008), with one of two children with migration background coming from a low socioeconomic status household. With regard to different language subgroups, Dubowy et al. (2008) found that the average ISEI of families with two non-native German parents is lower compared to that of families with a single non-native German parent or families with two native German parents. At the same time, this study showed that socioeconomic status explained differences in preschool grammar, vocabulary, nonverbal competencies, and verbal working memory among children with two, one, and without native speaking parents. However, even after considering socioeconomic status, unexplained differences between the language groups in all competence measures still existed. Taken together, these findings point to socioeconomic status as an important confounding factor to be considered when studying children's competencies with different language backgrounds.

Objectives and Research Questions

This current study investigates the reading comprehension (and its preschool predictors) of monolingual, L1 bilingual, and L2 bilingual German children. The focal question refers to L1 bilingual children and whether they are more similar to monolingual or L2 bilingual children concerning mean levels of reading comprehension and its preschool predictors as well as the predictive relevance of preschool predictors of reading comprehension. Thus, we explore two main research questions:

Research Question 1: Mean differences between language groups

Following previous studies, it is assumed that monolinguals are superior to L1 bilingual and L2 bilingual children in reading comprehension and linguistic abilities. Additionally, due to (a) the number of languages they are exposed to and (b) the dominant language of the bilingual children (the used stimuli are German words), it is expected that L1

bilingual children outperform monolingual and L2 bilingual children in phonological awareness. Concerning memory span and working memory, previous findings are rather inconsistent, and from a theoretical perspective, it is not clear whether different levels of memory span and working memory can be expected for bilingual children than for monolingual children. Accordingly, an explorative analysis is implemented for these constructs. Furthermore, we propose that the differences in reading comprehension and its predictors among the three groups can be partially accounted for by socioeconomic status. More specifically, we expect that socioeconomic status confounds group comparisons in domains in which aspects of the home environment and culture play an important role, such as linguistic abilities and reading comprehension.

Research Question 2: Differential associations between reading and its preschool predictors

Previous research indicates that linguistic abilities in the target language may be more important for predicting reading comprehension in bilingual children than in monolingual children (e.g. Droop & Verhoeven, 2003), possibly because top-down strategies can be observed earlier in bilingual than in monolingual children (Verhoeven, 1994). Therefore, we expect that linguistic abilities are a better predictor of reading comprehension in L1 bilingual and L2 bilingual children than in their monolingual peers. Based on earlier findings (e.g., Limbird & Stanat, 2006), we also expect a lower association between phonological awareness and reading in bilingual than in monolingual children.

Method

Sample and Procedure

The participants were part of the longitudinal *National Educational Panel Study* (Blossfeld, Roßbach, & Maurice, 2011) in Germany that follows representative samples of children, adolescents, and adults across their life course. The present study focuses on three measurement waves of the kindergarten cohort that took place one and two years before

mandatory school entry (waves 2 and 1, respectively) as well as in grade 4 of elementary school (wave 3). The cohort included a total of N = 2,944 children (1,439 girls) who had a mean age of M = 5.00 years (SD = 0.36) at the first wave. In kindergarten, the children were individually tested by trained interviewers in a dedicated room at the respective kindergarten. Additionally, parents were interviewed by phone. After entering elementary school, children attending schools participating in the NEPS were tested in groups at their respective schools. Children attending other schools were tracked and individually tested at their homes (see Würbach, 2018). Selectivity analyses showed only minor sample selection bias across the three waves due to nonresponse (see supplementary material).

The children were classified into three language groups based on parental reports of the first and second languages of the child. Children were classified as monolinguals if parents reported that the children's language was only German. Children were assigned to the L1 bilingual group if parents reported that the children's primary language was German and that the children were learning a second language in addition to German. Finally, if German was reported as a second language, these children were classified as L2 bilingual children. All bilingual children had started to learn the second language before the age of three (cf. Jared, 2015; Zhao & Li, 2010). Children who were exposed to more than two languages (i.e., multilinguals) or for whom no information on the spoken language was available were not considered (n = 555). This resulted in 1,842 monolingual, 269 L1 bilingual, and 237 L2 bilingual children. Basic sociodemographic information on the three groups is summarized in Table 1.

Insert Table 1 here

Instruments

Measures of receptive vocabulary and receptive grammar were used as indicators of linguistic abilities. Measures of memory span, working memory, and phonological awareness served as indicators of phonological information processing.

Receptive vocabulary. A modified German version of the *Peabody Picture Vocabulary Test* (Berendes, Weinert, Zimmermann, & Artelt, 2013; Dunn, 2004; Roßbach, Tietze, & Weinert, 2005) designed for children between ages 3 and 6 (cf. Roßbach et al., 2005) was administered in wave 1. The test included 77 items that required children to select one out of four pictures corresponding to a spoken word. The marginal reliability based on a two-parametric item response model (Birnbaum, 1968) was good, with .95. Respondents' proficiencies in receptive vocabulary (i.e., the understanding of spoken word meanings) were given as weighted maximum likelihood estimates (Warm, 1986).

Receptive grammar. In wave 1, a shortened German version of the *Test of Reception of Grammar* (Fox, 2006) was administered. For each of the 48 items, the children had to identify one out of four pictures that corresponded to a spoken sentence (see Lorenz, Berendes, & Weinert, 2017, for further details). The marginal reliability based on a two-parametric item response model (Birnbaum, 1968) was excellent, with .93. Respondent scores were estimated as weighted maximum likelihood estimates (Warm, 1986).

Memory span. The memory span (German version) was measured with the digit recall subtest of the *Kaufman Assessment Battery for Children* (Melchers & Preuß, 2009) in wave 2. The test was administered in German and included 12 items that required children to reproduce an orally presented sequence of numbers. A two-parametric item response model resulted in a good marginal reliability of .82.

Working memory. The digit span backward, a subtest from the *Hamburg Wechsler Intelligence Test for Children III* (Tewes, Rossmann, & Schallberger, 1999), was administered in wave 2. Originally, the test included 14 items and was administered in

German. However, because many items were too difficult for the children at this age, resulting in predominantly incorrect responses, only a subset of six items was selected. For each item, the children had to reproduce an orally presented sequence of numbers in reverse sequence. Despite the short test length, the test resulted in an acceptable marginal reliability of .70. Scores for each child were calculated as weighted maximum likelihood estimates (Warm, 1986).

Phonological awareness. In wave 2, an onset-rhyme task was administered that was derived from the subtest *Build the Right Word* of a test for phonological awareness (Fricke & Schäfer, 2008). On this task, the children heard an onset (e.g., "N") and a rhyme (e.g., "uss") with a delay of one second. Then, they were asked to assemble the onset and rhyme into a meaningful word (i.e., "Nuss", in German meaning "nut"). This type of phonological awareness is measured before children obtain their first official instruction in reading literacy. The weighted maximum likelihood estimates (Warm, 1986) represented the measure of respondents' phonological awareness. The marginal reliability was good, with .79.

Reading comprehension. A reading comprehension test that was specifically developed for the NEPS was administered in grade 4 of elementary school (wave 3). The test included five texts referring to different everyday situations and 31 multiple-choice items referring to these texts. Further details on the theoretical framework guiding the test construction are given in Gehrer, Zimmermann, Artelt, and Weinert (2013), while the psychometric properties of the administered test are summarized in Author et al. (2017). The responses were scaled using a one-parametric item response model (Rasch, 1960), resulting in a satisfactory marginal reliability of .80. Reading proficiencies for each respondent were estimated as weighted maximum likelihood estimates (Warm, 1986).

Socioeconomic background. The socioeconomic background of the children was given by the parental occupation as reflected in the *International Socio-economic Index of Occupational Status* (ISEI-08; Ganzeboom, 2010). In case the parents had different ISEI-08

values, the highest value (HISEI) was selected. The HISEI has a theoretical range from 12 to 99, with larger values indicating a higher status.

Statistical Analyses

The research questions were examined by regressing reading comprehension on the hypothesized variables, that is, linguistic abilities, memory span, working memory, and phonological awareness. Linguistic abilities were modeled as a latent variable with vocabulary and grammar scores as indicators. Differences between the three language groups were evaluated in a multigroup model that constrained the selected parameters across groups. Sensitivity analyses were conducted by including socioeconomic status as a covariate in the model and evaluating the focal effects. These analyses were based on 30 plausible values drawn for each cognitive test and thus allow for the analysis of latent relationships (cf. Davier, Gonzalez, & Mislevy, 2009; Wu, 2005). The models were estimated in *R* version 4.0.2 (R Core Team, 2020) using the *lavaan* package version 0.6-6 (Rosseel, 2012) with a full information maximum likelihood estimator adopting a robust test statistic (Yuan & Bentler, 2000) and heteroscedasticity-consistent standard errors (Freedman, 2006).

Open Practices

Detailed information on the sample recruitment, assessment procedure, and measurement instruments is provided at http://www.neps-data.de. The anonymized data that allow reproducing the reported findings are available at https://doi.org/10.5157/NEPS:SC2:8.0.1. Moreover, the analysis code used to generate the reported findings can be accessed at https://osf.io/ugw2f/.

Results

Mean-Level Differences between Language Groups

In the first step, we evaluated mean-level differences in the administered measures between the three language groups. The respective effect sizes (Cohen's *d*) are given in Table 2. Generally, monolingual children outperformed bilingual children (L1 and L2) in

vocabulary and grammar, supporting the assumption of monolinguals' superior linguistic abilities. However, with Cohen's *d*s of 0.25 and 0.20, the respective effect sizes were rather small for L1 bilingual children. Respective effects were substantially larger between monolingual and L2 bilingual children (d = 0.82 and 0.61). Although monolingual children exhibited superior skills in vocabulary and grammar, there were few substantial differences for the other measures. While L1 bilingual children performed comparably on memory span, working memory, phonological awareness, and reading comprehension, L2 bilingual children tended to achieve slightly lower scores (*d*s between 0.16 and 0.30) than their monolingual peers. Concerning the two bilingual groups, L1 bilingual children performed better in vocabulary and grammar (d = 0.51 and 0.39). Moreover, there was a small, yet significant (p < .05) difference for reading comprehension in the same direction. Importantly, L2 bilingual children had a significantly lower socioeconomic status than monolingual (d = 0.52) or L1 bilingual children (d = 0.43). Thus, differences in the social composition of the three language groups might have distorted the group comparisons. Therefore, we repeated the mean-difference analyses controlling for the socioeconomic status of the children (see Table 2).

Insert Table 2 here

After controlling for socioeconomic status, the small differences between monolingual and L2 bilingual children in memory span, working memory, and phonological awareness were substantially reduced, resulting in nonsignificant effects (*d*s between 0.05 and 0.13). The difference in reading comprehension remained significant (p < .05) but was substantially smaller (d = 0.16). A similar (albeit not significant) difference between the two bilingual groups in reading comprehension was observed. However, the previously observed effects for vocabulary and grammar were robust. Even after controlling for socioeconomic status, monolingual children performed significantly better on these tasks than L2 bilingual children.

Similarly, L1 bilingual children achieved higher scores on the vocabulary and grammar tests than L2 bilingual children. Thus, socioeconomic status accounted for differences in some early competences between language groups but could not significantly explain the differences in vocabulary and grammar among children with different first languages.

Differences in Predictors of Reading Comprehension between Language Groups

Predictors of reading comprehension in the three language groups were examined using a multigroup regression that modeled linguistic abilities as a latent factor with two indicators. The respective results in Table 3 show that reading comprehension was primarily predicted by linguistic abilities. The respective effect sizes between $\beta = .22$ and .31 suggested few differences between the three groups. Indeed, constraining the effect of language abilities on reading comprehension across groups did not result in a loss of fit, $\chi^2(df = 2) = 0.67$, $p = .715$. The other measures had negligible effects on reading comprehension and were not significant ($p > .05$) in the two bilingual groups. As an overall test of moderation, the unconstrained model was compared to a model that constrained all effects on reading comprehension across groups. The respective difference test was not significant, $\chi^2(df = 8) = 1.10$, $p = .998$, indicating that the four measures predicted reading comprehension comparably among monolingual and bilingual children. Finally, we replicated the analyses controlling for socioeconomic status (see Table 3). Although socioeconomic status explained approximately 1% to 3% of the incremental variance in reading comprehension, the effects of the other measures were largely unaffected. Linguistic abilities had the strongest effect on reading comprehension, while memory span, phonological awareness, and working memory resulted in negligible effects that were not significant in the bilingual groups. Again, constraining the effects on reading comprehension across groups resulted in no loss of fit, $\chi^2(df = 8) = 0.97$, $p = .998$, suggesting that the language group did not act as a relevant moderator.

Insert Table 3 here

Discussion

The present study focused on the reading comprehension of monolingual, L1 bilingual, and L2 bilingual German children at the end of primary school and its predictors at kindergarten age. These analyses provided several important findings.

First, the reading comprehension of monolingual children, as well as L1 bilingual children, was superior to that of L2 bilingual children at the end of primary school. However, the respective effects were relatively small, with $d = 0.30$ for monolinguals and $d = 0.21$ for L1 bilingual children. In contrast, the level of reading comprehension between monolingual and L1 bilingual children was rather comparable ($d = 0.09$). These results basically suggest that without controlling for socioeconomic status, the level of reading comprehension of L1 bilingual children was more similar to monolingual than to L2 bilingual children. This pattern of results fell in line with previous research on different components of German language abilities in ninth graders (Hesse et al., 2008). However, our observed effect sizes were slightly less pronounced than those found in other large-scale studies in Germany (e.g., Schleicher, 2019; Stanat, Schipolowski, Rjosk, Weirich, & Haag, 2016). This might be a consequence of our relatively strict criterion for the classification of bilingual children, according to which bilingual children had started to learn the second language before the age of three (cf. Jared, 2015; Zhao & Li, 2010). In addition, all children in our sample were born in Germany or had come to Germany before the age of four. Nevertheless, the findings confirm notable differences in reading comprehension between monolingual and L2 bilingual children at the end of primary school. Given previous research assessing reading comprehension in Grade 9 (Hesse et al., 2008; Schleicher, 2019), it appears that these differences do not diminish but rather increase as students get older. Since this study does not include a subsequent measurement point on reading comprehension in secondary school, we cannot provide inferences about the possibility of a Matthew effect, which proposes that the gap between skilled and less skilled readers becomes greater over time (cf. Stanovich, 1986).

Second, the observed differences in reading comprehension were considerably smaller when the socioeconomic background of the children was acknowledged. Thus, the children's language background seems to be confounded by their socioeconomic status, which partly explains the lower reading comprehension of the bilingual children (see also Dubowy et al., 2008; Kieffer, 2010). Taking these effects into account, the reading comprehension gap decreased substantially. However, this finding only applies to the comparisons with L2 bilingual children. As the socioeconomic background of L1 bilingual children is similar to that of monolingual children, controlling for socioeconomic status does not affect the group differences between monolingual and L1 bilingual children. Overall, it can be assumed that higher status parents act as children's role model with more favorable attitudes towards reading and thus provide more enriching activities that promote literacy, such as buying children's books, going to the library, or engaging in joint reading activities (Bradley & Corwyn, 2002; Coddington, Mistry, & Bailey, 2014; McElvany, Becker, & Lüdtke, 2009; Sonnenschein & Sun, 2016). The finding that the socioeconomic status is comparable between the monolingual and the L1 bilingual groups might also be an indication that the parents in both groups are similar in their overall parental social capital and that they foster their children to a similar extent with regard to their literacy development. Furthermore, our results suggest that socioeconomic background already had an impact on preschool predictors of reading (for vocabulary, see Hart & Risley, 1995; Roberts, Jergens, & Burchinal, 2005) and that these influences add to social disparities in later reading comprehension.

Third, regarding the predictors of reading comprehension, a different pattern of results was obtained for linguistic abilities than for indicators of phonological information processing. For linguistic abilities, pronounced differences between the three language groups were found, with L2 bilingual children achieving lower scores on tests of receptive vocabulary and receptive grammar than monolingual and L1 bilingual children. Moreover, L1 bilingual children scored slightly lower than monolingual children. All of these differences

remained substantial when the socioeconomic background was controlled for. These findings support prior research (e.g., Dubowy et al., 2008; Hesse et al., 2008) that reported relatively stronger differences in linguistic abilities compared to other cognitive skills, such as reading comprehension and nonverbal competences. These results suggested that both the amount and sequence of languages learned have a substantial contribution to preschool vocabulary and grammar in the majority language. As it can be assumed that the amount of German language exposure is highest in the group of monolingual children, intermediate in the group of L1 bilingual children, and lowest in the group of L2 bilingual children, the findings are in line with the notion that the amount of language exposure is a crucial factor that explains the lower language proficiency level in bilingual children (Haman et al., 2017; Hoff, 2015). On the other hand, concerning phonological information processing, only small differences emerged between the language groups, and these vanished after accounting for the children's socioeconomic background. Accordingly, these results do not support the assumption that access to more phonological information leads to benefits in phonological awareness (e.g., Bialystock, 2013). However, as the stimuli in our study were real German words, we cannot disentangle whether vocabulary demands may have had a confounding effect on these findings (e.g., Chiappe et al., 2002). Therefore, it would be preferable to implement a semantically fair phonological awareness test (e.g., a pseudowords task) in further research.

Finally, the preschool predictors of reading comprehension were similarly related to reading in grade 4 in the three language groups. In all groups, linguistic abilities predicted reading comprehension more strongly than phonological processing. Our results, therefore, underline previous findings on the importance of linguistic abilities for the development of reading comprehension in later grades (Ebert & Weinert, 2013; Gathercole & Baddeley, 1989) when the decoding skills of children are more advanced. Given that the time interval between our first measurement point in kindergarten and the assessment of reading comprehension at the end of primary school is very long (nearly five years), the strength of

the observed relationship is remarkable. In contrast to the findings of prior studies (Droop & Verhoeven, 2003; Lervåg & Aukrust, 2010; Limbird & Stanat, 2006; Verhoeven, 2000), our results show that vocabulary and grammar of the majority language do not have a differential impact on reading in the three language groups but seem similarly important. Furthermore, it might be assumed that phonological processing skills are more relevant for basic reading skills (Ebert & Weinert, 2013) than the reading comprehension skills studied in the present study. At the end of primary school, phonological processing appears to become less relevant, probably because the decoding proficiency of most children has achieved an advanced level and children have started to read in order to learn the reading materials rather than in order to learn how to read.

Summary of Central Findings

Taken together, our findings show that monolingual, L1 bilingual, and L2 bilingual children differ in their mean levels concerning linguistic abilities and reading comprehension. Although the pattern of results is similar across the different indicators: monolingual children outperformed L2 bilingual children, while the mean scores of L1 bilingual children were located between the two other groups, monolingual and L1 bilingual children were only different in the components of linguistic abilities. This pattern remained even after controlling for the social background of the children. This indicates that the amount of exposure to the majority language and the time point of starting to acquire it (Kovelman, Baker, & Petitto, 2008) are more important for language and reading development than acquiring two languages at the same time. Otherwise, comparable levels would have been expected for L1 bilingual and L2 bilingual children. On the other hand, the three groups do not substantially differ regarding the associations between reading comprehension in its preschool predictors. Hence, monolingual and bilingual children seem to be more similar than different in their profiles of reading predictors (Marx et al., 2015; Proctor, Carlo, August, & Snow, 2005; Tracy & Gawlitzek-Maiwald, 2000).

Implications and Conclusion

As linguistic abilities have been shown to be significant predictors for reading comprehension, a promising educational intervention would be to promote children's vocabulary and grammatical knowledge. According to the incidental vocabulary learning hypothesis (Nagy & Herman, 1985), students learn words through various literacy experiences, particularly reading. Nevertheless, since reading comprehension depends on the amount of words recognized, and a text with more than 2% of unknown words may be difficult to comprehend (Carver, 1994), it is hard to expect that children's language proficiency will increase only through an extensive reading program that is usually conducted in the primary and secondary schools. Rather, interventions that could be implemented by educational institutions in this respect should be focused on both the depth and the breadth of vocabulary knowledge (Ordóñez, Carlo, Snow, & McLaughlin, 2002) as well as teaching cognate awareness (Nagy, García, Durgunoğlu, & Hancin-Bhatt, 1993). In addition, targeting family, especially parents, as part of the intervention program, as have been implemented in several European countries (Kambel, 2014) seems to be a promising approach as well.

The findings of this study also support basic principles advocated by the ecological framework (Bronfenbrenner, 1992) about the crucial role of the family in children's development. Particularly, a family's socioeconomic status contributes to the reading comprehension and phonological processing of children, which partly explains the effect of language background. It is important to note that socioeconomic status and migration background are two aspects that are frequently mentioned in the discourses about social disparities and educational inequalities (Aguiar et al., 2020). Considering that a steady link between socioeconomic status and children's cognitive competence is likely to be mediated by home literacy (Coddington et al., 2014; McElvany et al., 2009), it is essential to enhance children's exposure to literacy activities at home (e.g., HIPPY project at http://hippy-international.org/), specifically if the children come from socially disadvantaged households.

Given the relevant finding on educational disparities, it is crucial for researchers, policy makers, educational practitioners, as well as caregivers to be aware of potential issues that may link to this specific finding. Programs that target to support developmental outcomes of children from disadvantaged households could be designed, evaluated, and modified to ensure their effectiveness. Particularly in Germany with a clear link between socioeconomic status and migration backgrounds, the competence gap between native and non-native children should be included in the educational agenda.

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Table 1.

Sample Description by Language Group and Measurement Wave

	Monolinguals	Bilinguals L1	Bilinguals L2
Wave 1 (kindergarten 1)			
Girls (%)	49%	45%	48%
Age (*M* / *SD*)	4.99 / 0.36	5.00 / 0.34	5.00 / 0.35
HISEI (*M* / *SD*)	58.76 / 19.08	56.24 / 19.60	44.01 / 20.72
N	1,842	269	237
Wave 2 (kindergarten 2)			
Girls (%)	49%	44%	48%
Age (*M* / *SD*)	5.90 / 0.32	5.89 / 0.32	5.87 / 0.33
HISEI (*M* / *SD*)	59.18 / 19.00	56.48 / 19.59	43.29 / 20.53
N	1,709	239	224
Dropout (%)	7%	11%	5%
Wave 3 (grade 4)			
Girls (%)	51%	48%	50%
Age (*M* / *SD*)	9.68 / 0.33	9.68 / 0.35	9.60 / 0.32
HISEI (*M* / *SD*)	62.31 / 18.38	60.39 / 19.96	46.15 / 23.05
N	1,047	130	90
Dropout (%)	43%	52%	62%

Note. *N* = Sample size. Dropout = Percentage of unit nonresponse from wave 1; HISEI = Highest International Socio-Economic Index of Occupational Status (Ganzeboom, 2010).

Table 2.

Standardized Mean Differences between Language Groups

	Means (standard deviations)			Cohen's *d* (with 95% CI)		
	Mo	L1	L2	Mo vs. L1	Mo vs. L2	L1 vs L2
Without control variables						
Receptive vocabulary	0.20 (1.00)	-0.21 (1.24)	-1.10 (1.22)	0.25* (0.11, 0.40)	0.82* (0.65, 0.99)	0.51* (0.32, 0.71)
Receptive grammar	0.13 (1.01)	-0.17 (1.13)	-0.81 (1.18)	0.20* (0.06, 0.35)	0.61* (0.45, 0.76)	0.39* (0.21, 0.57)
Memory span	0.16 (1.11)	-0.16 (1.12)	-0.09 (1.05)	0.00 (-0.13, 0.13)	0.16* (0.03, 0.29)	0.16 (-0.02, 0.34)
Working memory	0.11 (1.10)	-0.09 (1.16)	-0.29 (1.19)	0.13 (-0.01, 0.26)	0.24* (0.10, 0.39)	0.12 (-0.07, 0.30)
Phonological awareness	0.12 (1.18)	-0.04 (1.20)	-0.21 (1.20)	0.05 (-0.08, 0.17)	0.20* (0.06, 0.34)	0.15 (-0.03, 0.33)
Reading comprehension	-0.01 (1.09)	-0.14 (1.10)	-0.46 (1.09)	0.09 (-0.06, 0.23)	0.30* (0.16, 0.44)	0.21* (0.03, 0.39)
Socioeconomic status	58.76 (19.07)	56.24 (19.57)	44.01 (20.67)	0.09 (-0.04, 0.23)	0.52* (0.38, 0.67)	0.43* (0.24, 0.62)
Controlling for socioeconomic status						
Receptive vocabulary	0.18 (0.99)	-0.20 (1.23)	-0.91 (1.19)	0.24* (0.10, .39)	0.71* (0.52, 0.90)	0.42* (0.21, 0.63)
Receptive grammar	0.11 (0.99)	-0.16 (1.11)	-0.60 (1.13)	0.18* (0.05, 0.32)	0.47* (0.30, 0.64)	0.27* (0.08, 0.47)
Memory span	0.13 (1.08)	0.17 (1.09)	0.06 (1.02)	-0.03 (-0.15, 0.10)	0.05 (-0.10, 0.20)	0.08 (-0.11, 0.27)
Working memory	0.09 (1.07)	-0.08 (1.14)	-0.12 (1.17)	0.11 (-0.03, 0.24)	0.13 (-0.03, 0.30)	0.03 (-0.17, 0.22)
Phonological awareness	0.09 (1.15)	0.06 (1.17)	-0.01 (1.16)	0.02 (-0.10, 0.15)	0.06 (-0.09, 0.22)	0.04 (-0.15, 0.23)
Reading comprehension	-0.04 (1.03)	-0.13 (1.05)	-0.27 (1.04)	0.06 (-0.08, 0.19)	0.16* (0.00, 0.31)	0.10 (-0.09, 0.29)

Note. Based upon 30 plausible values. Mo = Monolinguals, L1 = Bilinguals L1, L2 = Bilinguals L2.
* $p < .05$

Table 3.

Predictors of Reading Comprehension by Language Group

	Monolinguals		Bilinguals L1		Bilinguals L2	
	B (*SE*)	β	*B* (*SE*)	β	*B* (*SE*)	β
Model 1: without control variables						
Linguistic abilities	0.28* (0.05)	.22	0.30* (0.10)	.29	0.32* (0.10)	.31
Memory span	0.18* (0.03)	.20	0.14 (0.09)	.17	0.12 (0.09)	.14
Working memory	0.12* (0.04)	.13	0.09 (0.10)	.10	0.10 (0.11)	.10
Phonological awareness	0.12* (0.04)	.12	0.12 (0.10)	.13	0.11 (0.10)	.12
R^2	.18		.19		.17	
Model 2: controlling for socioeconomic status						
Linguistic abilities	0.25* (0.05)	.20	0.29* (0.09)	.28	0.29* (0.10)	.28
Memory span	0.15* (0.03)	.18	0.12 (0.09)	.14	0.10 (0.09)	.11
Working memory	0.10* (0.04)	.11	0.07 (0.10)	.07	0.09 (0.11)	.09
Phonological awareness	0.09* (0.04)	.10	0.11 (0.09)	.12	0.10 (0.09)	.12
Socioeconomic status	0.01* (0.00)	.20	0.01* (0.01)	.20	0.01 (0.01)	.15
R^2	.21		.22		.18	

Note. *B* = Unstandardized regression weight (with standard error in parenthesis), β = Standardized regression weight.
* $p < .05$

Supplementary material for

Reading Comprehension of Monolingual and Bilingual Children in Primary School: The Role of Linguistic Abilities and Phonological Processing Skills

- Analyses of Sample Attrition
- Differential Item Functioning Analyses

Analyses of Sample Attrition

Similar to other longitudinal studies (e.g., Zinn & Gnambs, 2018), substantial nonresponse rates were observed over the course of the three measurement waves. About 7% of the children dropped out in wave 2, and 54% did not participate in wave 3. To examine whether nonresponse propensity was systematically associated with our study variables, the dropout indicator for each wave (0 = dropout, 1 = participation) was regressed on various sociodemographic and cognitive indicators (see Table S1). These analyses showed that participation propensity was significantly ($p < .05$) associated with the parent's socioeconomic status (cf. Ganzeboom, 2010). Children from higher status households were more likely to participate in waves 2 and 3. Moreover, dropout rates were larger for bilinguals L1 (for wave 2) and children with lower verbal abilities (for wave 3). However, all effect sizes were rather small, that is, Cohen's $d \leq 0.24$. Therefore, these variables were included in the focal analyses to account for the unequal selection probabilities.

Table S1.

Attrition Analyses for Nonresponse at Waves 2 and 3

	Wave 2		Wave 3	
	B	*SE*	*B*	*SE*
Intercept	2.59	0.57	0.54	0.39
Girl (0 = no, 1 = yes)	0.01	0.08	0.09	0.05
Age (in years)	-0.22*	0.11	-0.09	0.08
HISEI [a]	0.09*	0.04	0.24*	0.03
Receptive vocabulary [a]	-0.08	0.06	0.14*	0.04
Receptive grammar [a]	0.09	0.06	0.01	0.04
Bilinguals L1 [b]	-0.24*	0.11	-0.14	0.08
Bilinguals L2 [b]	0.19	0.15	-0.15	0.10

Note. Probit regressions with nonresponse indicator (0 = dropout, 1 = participation) as dependent variables. HISEI = Highest International Socio-Economic Index of Occupational Status (Ganzeboom, 2010). [a] *z*-standardized; [b] Dummy-coded with monolinguals as reference category. * $p < .05$

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Differential Item Functioning Analyses

Differential item functioning (DIF) across the three language groups was evaluated using generalized logistic regression analyses (Magis, Raiche, Beland, & Gerard, 2011) that compared three regression models: (a) A regression of the cumulative response probabilities for each item on the observed trait score, (b) a regression that additionally included the language group as predictor, and (c) a regression that also acknowledged the interaction between trait score and group membership. A better fit of the second regression as compared to the first would indicate uniform DIF that distorts mean-level comparisons, whereas a better fit of the third regression would suggest non-uniform DIF that compromises the interpretation of bivariate relationships. Following established rule-of-thumbs, DIF is considered negligible or moderate when the difference in Pseudo-R^2 between two models does not exceed .035 or .070, respectively (Jodoin & Gierl, 2001). The DIF analyses were conducted in R version 4.0.2 (R Core Team, 2020) using the *difR* package version 5.1 (Magis, Beland, Tuerlinckx, & Boeck, 2010). For all cognitive instruments measurement invariance between monolingual, bilingual L1, and bilingual L2 children could be confirmed. Item for the administered tests exhibited neither non-negligible uniform nor non-uniform DIF. Thus, it seems unlikely that different test properties distorted the reported mean-level comparisons or comparisons of bivariate relationships between monolingual and bilingual children.

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